

RADIOLOGICAL RISK ASSESSMENT OF A THORIUM RICH AREA IN NORWAY

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The aim of the work was to assess doses and risk to humans due to outdoor gamma, radon and thoron exposures in one of the known high background radiation exposure sites in Norway. Chronic exposure to environmental background radiation is a growing public health concern. Norway is one of the world's largest thorium reservoirs, and one of the such sites is located in Telemark County, 120 km southwest of Oslo. The site, comprising Søve and Fen area, is also known as Fen Central Complex (FCC) and is situated close to a small town, Ulefoss. The FCC has one of the highest background radiation levels in Europe. This assessment was conducted to estimate doses and risk for cancers among human population in FCC region. The gamma dose rates in FCC were measured with hand held *Automess* (Genitron Instruments GmbH) during autumn (November 2009) and summer (July 2010) to assess potential seasonal differences in exposure. Similarly, radon and thoron air concentrations were measured with *Radosys®* etched-track detectors during autumn by placing the detectors at measuring sites between September and November 2009. All the measurements of gamma, radon and thoron were performed at the distance of one meter above the ground. The risk of lung cancer due to radon and thoron doses, and solid cancers and leukemia due to gamma doses were evaluated. The dose conversion and risk estimation factors recommended by ICRU¹, UNSCEAR² and ICRP³ were used to derive effective doses, equivalent doses and risk for cancers. Annual effective doses were calculated on the basis of measured background gamma dose rates during summer and autumn. Radon risk was excluded from the assessment due to its measured insignificant air concentrations. The mean doses and risk were averaged from the different surveyed sites in the FCC region. Annual effective doses during summer and autumn were found to be 10.32 mSv and 9.93 mSv respectively. The excess relative risk of solid cancers and leukemia from gamma exposure was 0.003 and 0.03 respectively. Likewise, the average equivalent dose to lung from thoron exposure was 75.26 mSv, and the subsequent excess relative risk of lung cancer was 5.75 %. Therefore, there exists a radiological risk to humans in Søve and Fen region. The risk is primarily due to thoron exposure. As per the ICRP recommendation⁴, the existing background radiation levels in the region indicate the need for intervention. It is important that several exposure scenarios should be taken into account while assessing the combined risk from gamma and thoron exposure and making recommendation for necessary intervention.

¹ICRU (2006). Variability of Environmental Radioactivity and Radiation. *J. ICRU*, 6, 15 - 24.

²UNSCEAR (2006). Effects of ionizing radiation. Volume 2, Annex E - Sources-to-effects assessment for radon in homes and workplace.

³Valentin J (2007). P103: The 2007 Recommendations of the International Commission on Radiological Protection. *Annals of the ICRP*, 37 (2-4), 1-332.

⁴ICRP Recommendation (2005). Assessed on 17.08.2010 via http://www.icrp.org/docs/2005_recs_CONSULTATION_Draft1a.pdf
